DETECTION AND TRACKING OF PEDESTRIANS USING DOPPLER LIDAR

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Pedestrian detection and tracking plays an essential role in diverse applications, such as autonomous vehicles and mobile service robots. This thesis presents a novel solution to pedestrian detection and tracking for urban scenarios based on Doppler LiDAR that records both position and velocity of the targets. The workflow consists of two stages. In the detection stage, the input point cloud is first segmented to form clusters frame by frame. A subsequent re-clustering process is introduced to separate pedestrians close to each other. While a simple speed classifier is able to extract most of the moving pedestrians, a supervised machine learning based classifier is adopted to detect pedestrians with insignificant radial velocity. In the tracking stage, pedestrians' state are estimated by a Kalman filter, which uses the speed information to measure the dynamic state of pedestrians. Based on the similarity between the predicted and detected states of pedestrians, a bipartite graph matching algorithm is adopted to associate the trajectories with the detections. The presented detection and tracking methods are tested on two datasets collected in San Francisco, California by a mobile Doppler LiDAR system. Compared with the detection method only based on the machine learning, the proposed two-step classifier can improve the detection performance particularly for pedestrians that are far from the sensor. The numerical results shows that the speed classifier increases F1-score by 10% on both datasets. Moreover, the Kalman filter with speed information is capable of providing more accurate estimation on the state of pedestrians, leading to an improved multiple objects tracking accuracy.